Systematic Checks for Coalescence in EPOS

31.01.2023

List of systematic checks

- Resonance cocktail uncertainty
- Uncertainty on the source size measurement
- Radius of the deuteron in the Gaussian wave function
- Δϕ-Δη correlations

Primordial Fraction

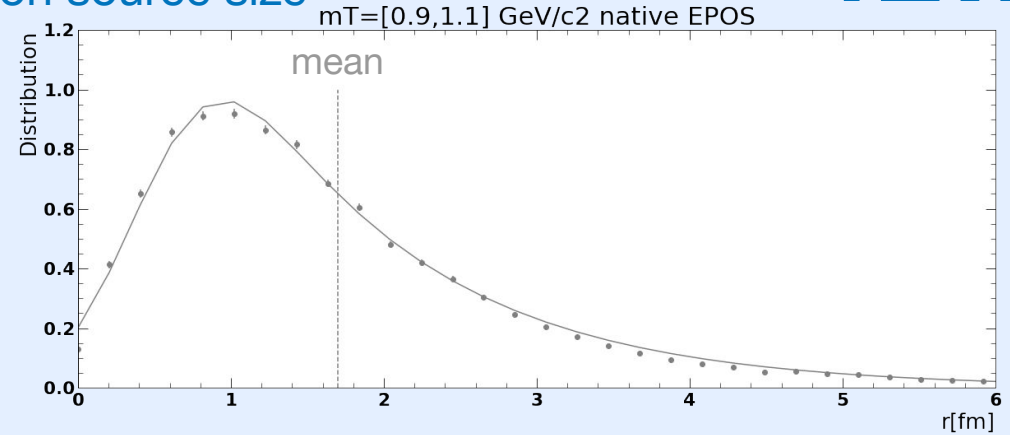
Impact on source size

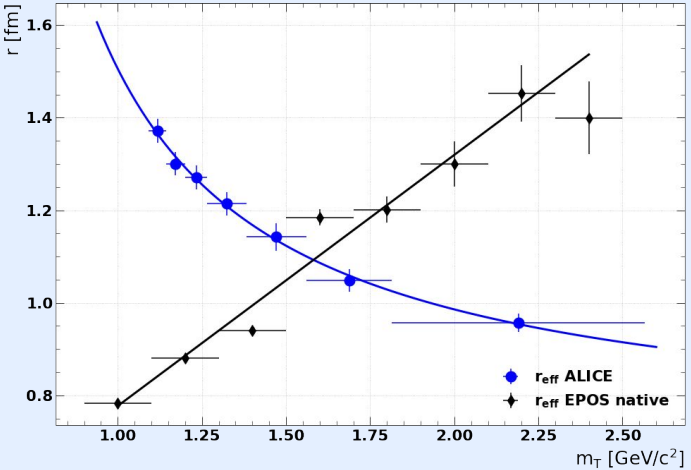
Recap: determining the source size:

1. Fitting distance distributions with exponentially modified gaussian
2. Determine the mean of the distribution
3. Relate this mean with the mean of a Gaussian distribution ($4/\sqrt{\pi}$) to get the value of the source size

Modelling the source size:

1. Do above steps for unaltered (only corrected resonance cocktail) EPOS
2. The resulting source size is called “native”
3. Use ratio ALICE/native as a scaling factor
4. Scale the distance of each pair by this factor





Primordial Fraction

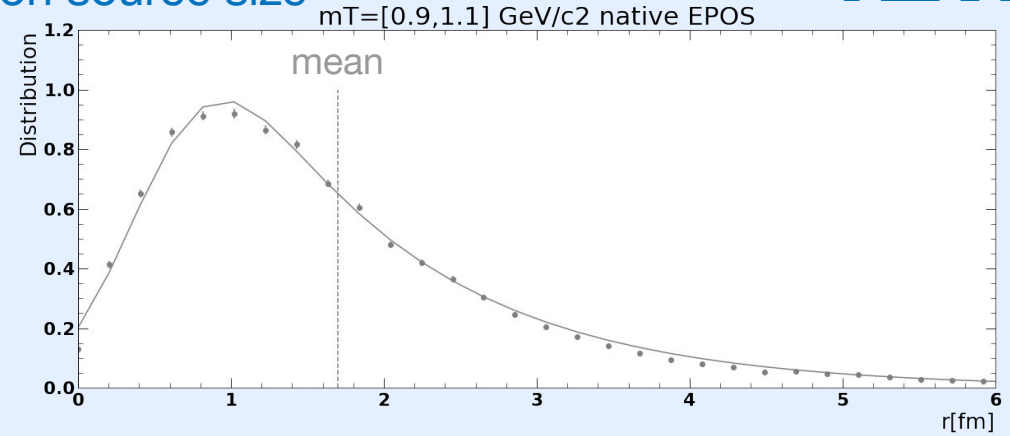
Impact on source size

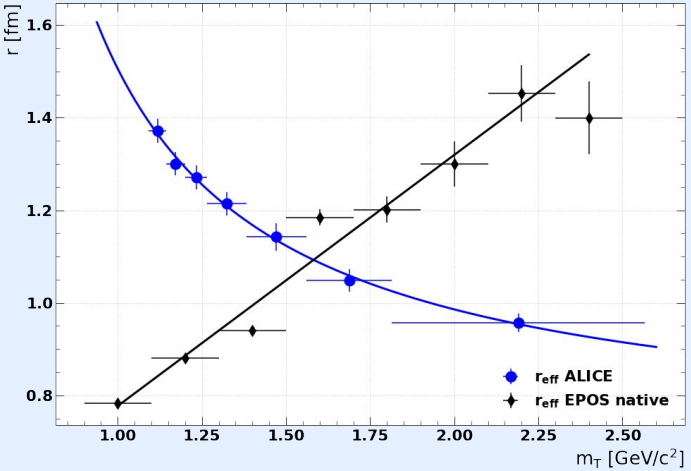
Recap: determining the source size:

1. Fitting distance distributions with exponentially modified gaussian
2. Determine the mean of the distribution
3. Relate this mean with the mean of a Gaussian distribution ($4/\sqrt{\pi}$) to get the value of the source size

Modelling the source size:

1. Do above steps for unaltered (**only corrected resonance cocktail**) EPOS
2. The resulting source size is called “native”
3. Use ratio ALICE/native as a scaling factor
4. Scale the distance of each pair by this factor





Primordial Fraction

Impact on source size

Vary primordial fraction (~36%) by +-10%

```
// scale primordial contribution up/down
if (std::abs(pid) == 1120 || std::abs(pid) == 1220)
{     If primordial:
    return weights[index] * 1.1;
}
// scale primordial contribution up/down
else
{     If resonance:
    return weights[index] * 0.9;
}
```

All results with 25% statistics!

Crude scaling!
Will change overall normalisation by ~2.5% ->
5% on deuteron spectra
(1.1*0.36+0.9*0.64=**0.972**)
(0.9*0.36+1.1*0.64=**1.028**)
No influence on source size!

Primordial Fraction

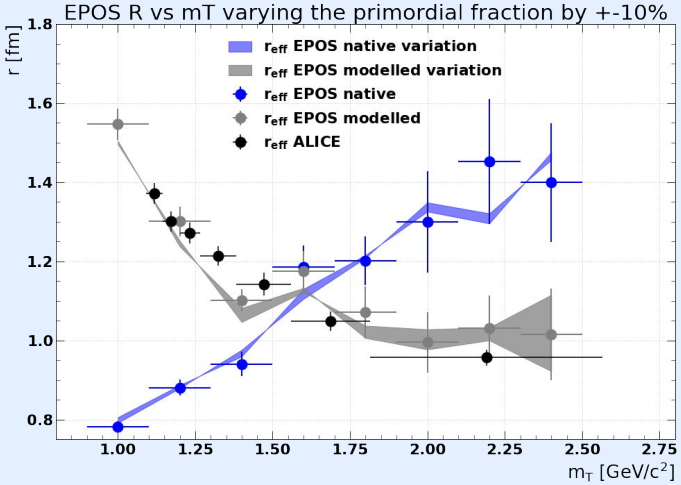
Impact on source size

Vary primordial fraction (~36%) by +-10%

All results with
25% statistics!

```
// scale primordial contribution up/down
if (std::abs(pid) == 1120 || std::abs(pid) == 1220)
{    If primordial:
    return weights[index] * 1.1;
}
// scale primordial contribution up/down
else
{    If resonance:
    return weights[index] * 0.9;
}
```

Crude scaling!
Will change overall normalisation by ~2.5% ->
5% on deuteron spectra
(1.1*0.36+0.9*0.64=**0.972**)
(0.9*0.36+1.1*0.64=**1.028**)
No influence on source size!



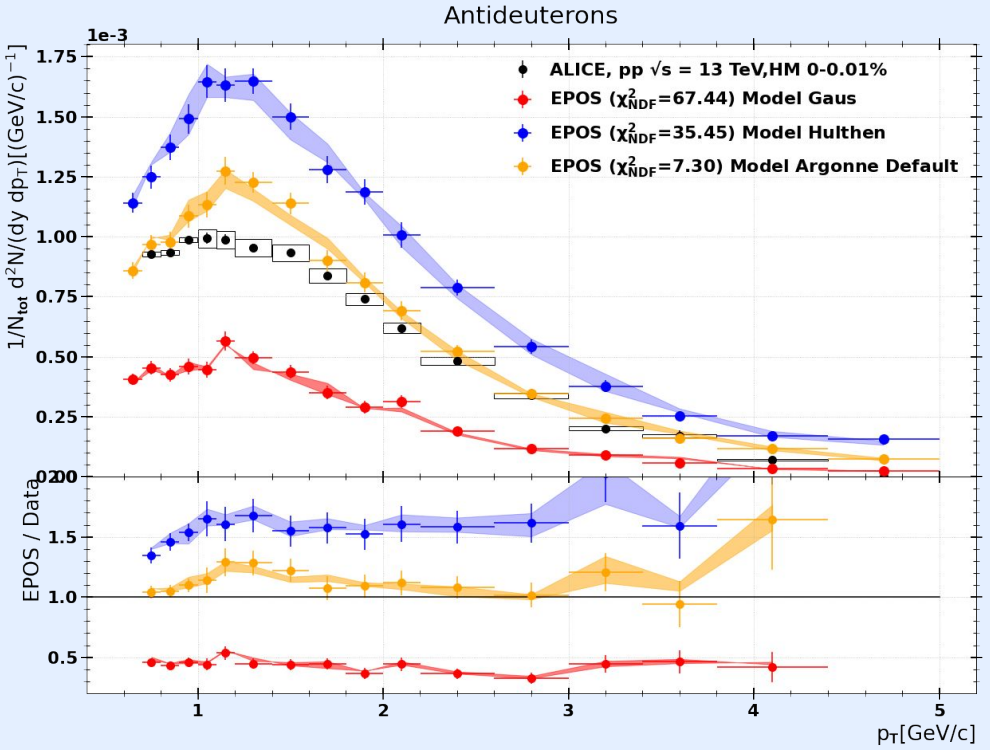
1. Change primordial fraction (+-10%)
2. Determine new native source size
3. Linear fit to new native source as “baseline”
4. Determine new scaling factor
5. Rerun coalescence afterburner with new scaling factor

- Baseline very little difference
- Overall statistically dominated
- Variation smaller than uncertainties of the model

Primordial Fraction

Deuteron Spectra

- Increased primordials scaled with ×1.05 (renormalization of protons)
- Decreased primordials scaled with 1/1.05
- Influence of primordial fraction smaller than statistical uncertainty (<10%)
- Probably a small systematic effect



Next Steps

- Deuteron spectra scaled up to account for D-wave
  → new method: adding S-wave and D-wave probabilities (to be done)
- Change the target source size from ALICE +-10% (*running..*)
- Radius of the deuteron in the Gaussian wave function (3.2 fm → 3.5 fm) (to be done)
- Reweight the Δϕ-Δη correlations to estimate the uncertainty from the wrong angular distributions (to be done)

Time estimate: conservatively **1 week**

Backup

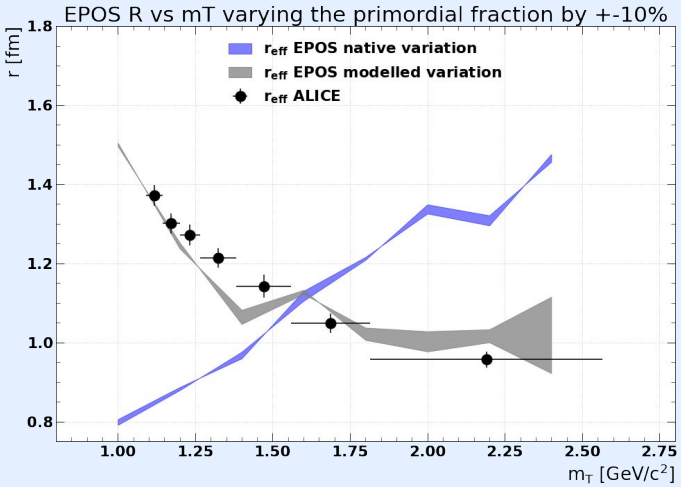
Primordial Fraction

Impact on source size

- Vary primordial fraction (~36%) by +-10%

```
// scale primordial contribution up/down
if (std::abs(pid) == 1120 || std::abs(pid) == 1220)
{
    return weights[index] * 1.1;
}
// scale primordial contribution up/down
else
{
    return weights[index] * 0.9;
}
```

Crude scaling!
Will change overall normalisation by ~2.5% -> 5% on deuteron spectra
No influence on source size!



Baseline very little difference
Overall statistically dominated

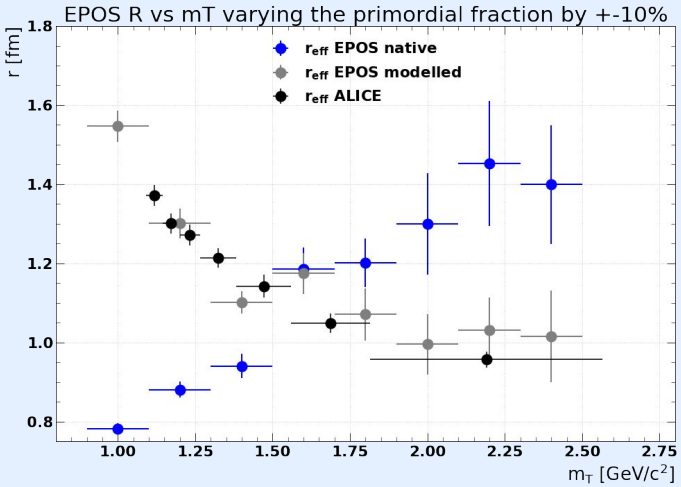
Primordial Fraction

Impact on source size

- Vary primordial fraction (~36%) by +-10%

```
// scale primordial contribution up/down
if (std::abs(pid) == 1120 || std::abs(pid) == 1220)
{
    return weights[index] * 1.1;
}
// scale primordial contribution up/down
else
{
    return weights[index] * 0.9;
}
```

Crude scaling!
Will change overall normalisation by ~2.5% -> 5% on deuteron spectra
No influence on source size!



Primordial Fraction

Impact on source size

- Vary primordial fraction (~36%) by +-10%

```cpp
// scale primordial contribution up/down
if (std::abs(pid) == 1120 || std::abs(pid) == 1220)
{
    return weights[index] * 1.1;
}
// scale primordial contribution up/down
else
{
    return weights[index] * 0.9;
}
```

Crude scaling!
Will change overall normalisation by ~2.5% -> 5% on deuteron spectra
No influence on source size!